



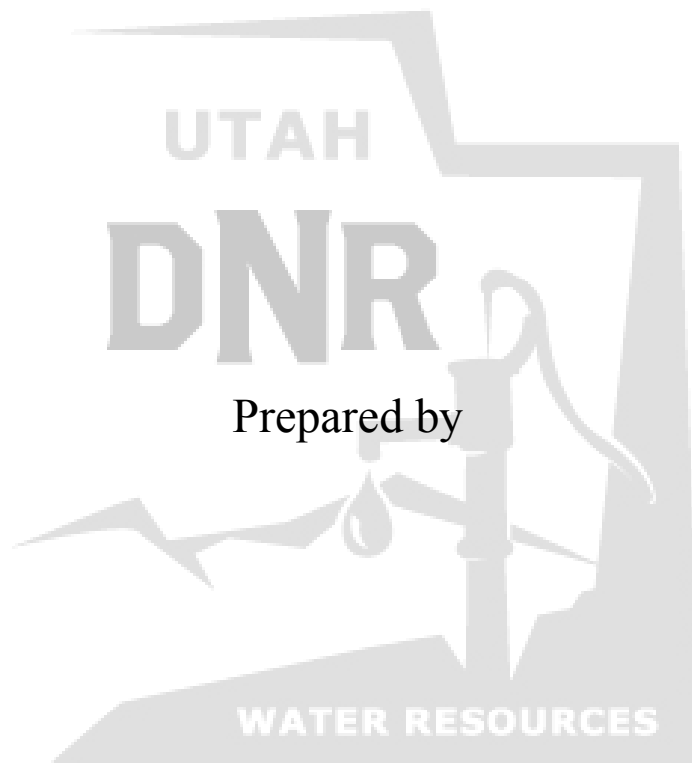
Water-Related Land Use Inventories

UTAH

Weber River Basin
2007 Inventory



A Water-Related
Land Use Inventory Report
of the
Weber River Basin



Prepared by

Utah Department of Natural Resources
Division of Water Resources

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ACKNOWLEDGMENTS

This report was prepared by Aaron Austin, GIS Analyst. The land use data summarized in this report were gathered under the direction of Todd Adams, Assistant Director, and supervised by Eric Edgley, Section Chief, Technical Services, Utah Division of Water Resources.

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WEBER RIVER BASIN

WATER-RELATED LAND USE INVENTORY

INTRODUCTION

Authority

In the 1963 general session, the Utah State Legislature charged the Division of Water Resources with the responsibility of developing a State Water Plan. This plan is to coordinate and direct the activities of state and federal agencies concerned with Utah's water resources. As a part of this objective, the Division of Water Resources collects water-related land use data for the entire state. This data includes the types and extent of irrigated crops as well as information concerning phreatophytes¹, wet/open water areas, dry land agriculture and residential/industrial areas.

The data produced by the water-related land use program are used for various planning purposes. Some of these include: determining cropland water use, evaluating irrigated land losses and conversion to urban uses, planning for new water development, estimating irrigated acreages for any area, and developing water budgets. Additionally, the data are utilized by many other state and federal agencies.

Previous Methods

The land use inventory methods used by the division in conducting water-related land use studies have varied with regard to the procedures used and the precision obtained. During the 1960s and 70s, inventories were prepared using large format vertical-aerial photographs supplemented with field surveys to label boundaries, vegetation types, and other water use information.

After identifying crops and labeling photographs, the information was transferred

onto a base map and then planimetered^{II} or "dot-counted" to determine the acreage. Tables for individual townships and ranges were prepared showing the amount of land in each land use category within each section. Data were then available for use in preparing water budgets.

In the early 1980s, the division began updating its methodology for collecting water-related land use data to take advantage of the rapidly growing fields of Remote Sensing and computerized Geographic Information Systems (GIS).

For several years during the early 1980's, the division contracted with the University of Utah Research Institute, Center for Remote Sensing and Cartography (CRSC), to prepare water-related land use inventories. During this period, water-related land use data was obtained by using high altitude color infrared photography and laboratory interpretation, with field checking.

In March 1984, several division staff members visited the California Department of Water Resources to observe its methodology for collecting water-related land use data for state water planning purposes.

Based on its review of the California methodology and its own experience, the division developed a water-related land use inventory program. This program included the use of 35mm slides, United States Geological Survey (USGS) 7-1/2 minute quadrangle maps, field-mapping using base maps produced from the 35mm photography and a computerized GIS to process, store and retrieve land use data.

Areas for survey were first identified from previous land use studies and any other available information. The identified areas

were then photographed using an aircraft carrying a high quality 35mm single lens reflex camera mounted to focus along a vertical axis to the earth. Photos were taken between 6,000 and 6,500 feet above the ground using a 24mm lens. This procedure allowed each slide to cover a little more than one square mile with approximately 30 percent overlap on the wide side of the slide and 5 percent on the slide's narrow side.

The slides were then indexed according to a flight-line number, slide number, latitude and longitude. All 35mm slides were stored in files at the division offices and cataloged according to township, range and section, and quadrangle map location.

Water-related land use areas were then transferred from the slide to USGS 7-1/2 minute quadrangle maps using a standard slide projector with a 100-200mm zoom lens. This step allowed the technician to project the slide onto the back of a quadrangle map. The image showing through the map was adjusted to the map scale with the zoom lens. Field boundaries and other water-use boundaries were then traced on the 7-1/2 minute quadrangle map.

Next, a team was sent to use the map in the field to check the boundaries and current year land use field data on the 7-1/2 minute quadrangles.

The final step was to digitize and process the field data using ARC/INFO software developed by Environmental Systems Research Institute (ESRI).

Present Methodology

Starting in 2000 with the land use survey of the Uintah Basin, the division further improved its land use program by using digital data for the purposes of outlining agricultural and other land cover boundaries. The division uses satellite data, USGS Digital Orthophoto Quadrangles (DOQs), National Agricultural Imagery Program (NAIP), and

other digital images in a heads-up digitizing^{III} mode for this process. This allows the division to use multiple technicians for the digitizing process.

Digitizing is done as line and polygon files using ArcMap 9.2 or ArcView 3.2 with a satellite image or DOQ image as a background with other layers added for reference. Boundary files are created in logical groups so that the process of edge-matching along quad lines is eliminated and precision is increased. All boundaries of individual agricultural fields, urban areas, and significant riparian areas are precisely digitized.

Once the process of boundary digitizing is done, boundary line files are converted to polygons and loaded onto tablet PCs. Field crews are then sent to label and field check the boundary file as well as the crop or land cover type for each polygon. Each tablet PC is attached to a GPS unit for real-time tracking to continuously update the field crew's location during the field labeling process. This improved process has saved the division much time and money and even greater savings will be realized as the new statewide field boundaries are completed. When the time comes to re-inventory a basin, existing boundaries will be used and will only be modified in areas where they have actually changed.

Once processed and checked, the data is filed in the State Geographic Information Database (SGID) maintained by the State Automated Geographic Reference Center (AGRC). Once in the SGID, the data becomes available to the public. At this point, the data is also ready for use in preparing various planning studies.

In conducting water-related land use inventories, the division attempts to inventory all lands or areas that consume or evaporate water other than natural precipitation. Areas not inventoried are mainly desert, rangeland and forested areas.

Wet/open water areas and dry land agriculture areas are mapped if they are within or border irrigated lands. As a result, the numbers of acres of wet/open water areas and dry land agriculture reported by the division may not represent all such areas in a basin or county.

During land use inventories, the division uses 11 hydrologic basins as the basic collection units. County data is obtained from the basin data. The water-related land use data collected statewide covers more than 2,700,000 acres of dry and irrigated agricultural land. This represents about 5 percent of the total land area in the state.

WEBER RIVER BASIN WATER-RELATED LAND USE DATA

Basin Description

The Weber River Basin covers approximately 2,500 square miles of the north-central area of Utah. This represents about 3% of the land area of the State. The basin's western boundary is formed by the 4,200 foot elevation contour along the shore of the Great Salt Lake. The northern, eastern, and southern boundaries are formed by the ridges of the Wasatch Range.

The basin spans all or part of five counties: Weber, Davis, Morgan, Summit, and Box Elder.*

Elevations in the basin range from 4,200 feet on the shore of the Great Salt Lake to over 11,200 feet in the mountains of the eastern portion of the basin.⁽¹⁾ The western edge of the Wasatch Range is generally known as the Wasatch Front. A gently sloping delta, known as the East Shore, extends between the Wasatch Front and the Great Salt Lake. A very large percentage of the population of the Weber River Basin resides on this East Shore area between North Ogden

and Bountiful. Other population concentrations are found in Park City, Huntsville, Morgan and Kamas.

The climate of the basin is typical of high mountain areas. Average annual precipitation ranges from approximately 12 inches in the lower elevations of the East Shore area to over 67 inches in the mountains.⁽²⁾ In 2007, annual precipitation values for the Weber River Basin ranged from approximately 8.9 inches in lower elevation areas to 49.2 inches in the mountains.⁽²⁾ The basin average in 2007 was about 20 inches, which is slightly lower than the average from 1971 to 2000 which was approximately 26.4 inches.⁽²⁾ Figure 1 compares precipitation in 2007 to the average from 1971 to 2000.

In the rugged terrain of the Wasatch Range, long, rigorous winters and short, cool summers are common. Temperature norms in the basin reach a January minimum of nearly 0 °F and a July maximum of more than 90 °F.

Figure 2 locates the Weber River Basin with respect to the Utah state and county borders and illustrates the water-related land

* In some past inventories, portions of Box Elder County around Willard Bay were inventoried as part of the Bear River Basin instead of the Weber River Basin.

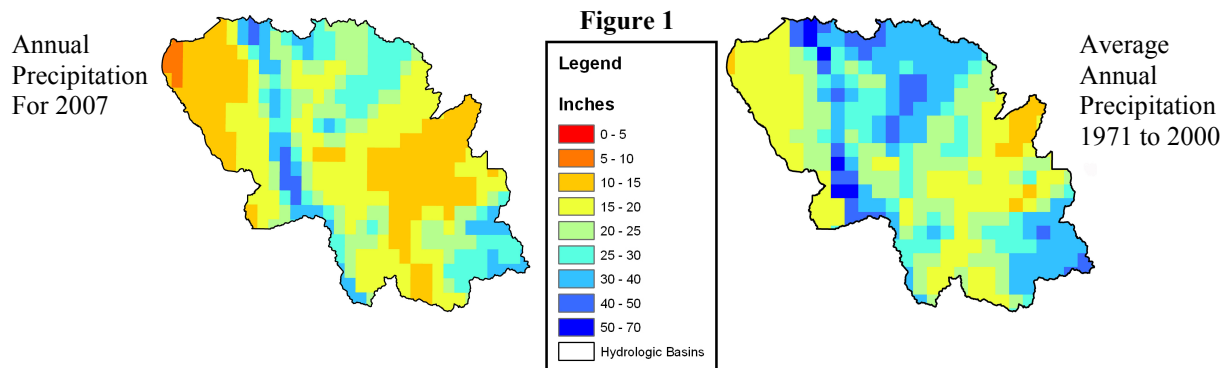
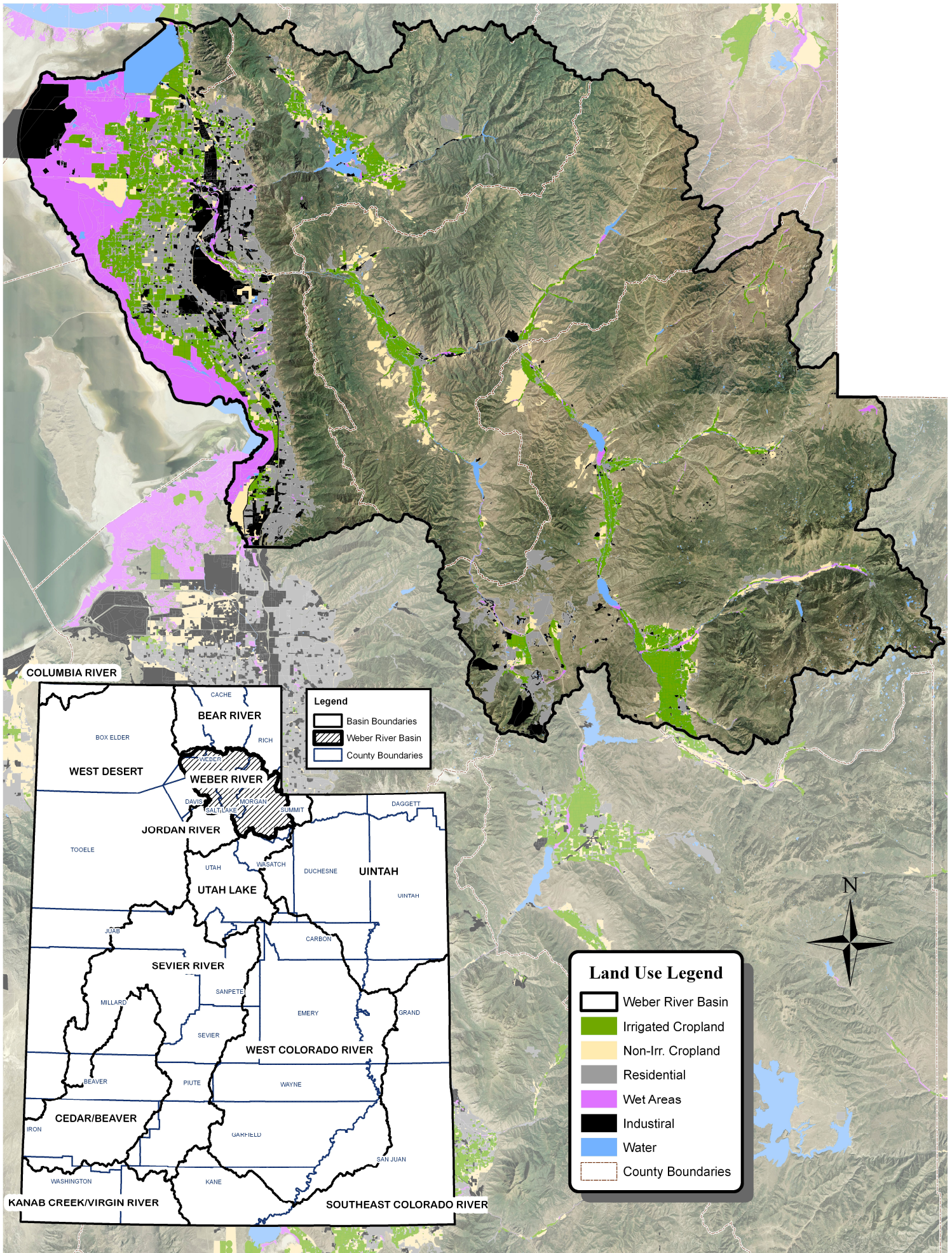


Figure 2 Mapped Water-Related Land Use in 2007 and Basin Location



use of the basin. It also indicates that the basin's agricultural areas are found mainly along the tributaries to the Weber River, the Weber River and the East Shore area. The figure also depicts the county lines within the basin.

Data Collection

The Division inventoried water-related land use in the Weber River Basin during the summer of 2007. Previous inventories were done in 1970*, 1987, 1999 and 2003. In 2007, the division inventoried nearly 382,679 acres of land in the Weber River Basin. This represents roughly 24

percent of the total land area in the entire basin.

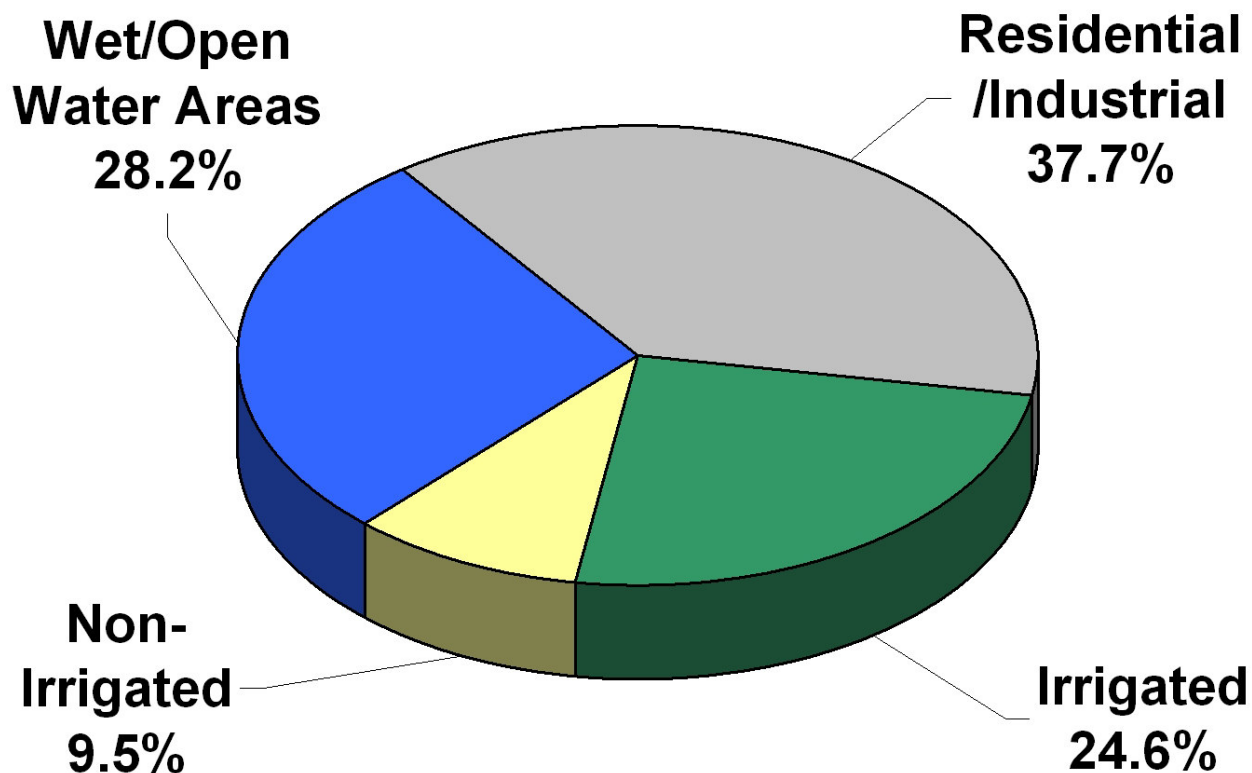
Data Summary

Of the nearly 382,679 acres inventoried in 2007, 94,206 were irrigated lands (including land that was sub-irrigated), 36,398 were non-irrigated (including land that was fallow and idle), 107,758 were wet/open water areas (including reservoirs and mountain lakes), and 144,317 were residential/industrial areas (including farmsteads and rural housing).

Figure 3 delineates the four categories of water-related land use listed above

* The data collected in 1970 are available in book form at the Utah Division of Water Resources

Figure 3 Delineation of Water-Related Land Use Categories within the Weber River Basin in 2007



by percentage.

The division has further classified the water-related land use within the basin. Figure 4 represents data from the surface irrigated and sub-irrigated cropland categories. The data are broken down into 15 different subcategories.

Total basin acreage for irrigated lands, non-irrigated lands, wet/open water areas, and residential/industrial are presented in Table 1 by county. Table 2 provides a comparison of acreage totals by survey year.

Due to changes in methodology, improvements in imagery, basin boundary

line updates and upgrades in software and hardware, increasingly more refined inventories have been made in each succeeding year of the Water-Related Land Use Inventory. While this improves the data we report, it also makes comparisons to past years difficult. Making comparisons between datasets is still useful, however; **increases or decreases in acres reported from one year to another cannot be construed to represent definite trends or total amounts of change up or down.** To estimate such trends or change, more analysis is required.

Figure 4 Breakdown of Irrigated Cropland within the Weber River Basin in 2007

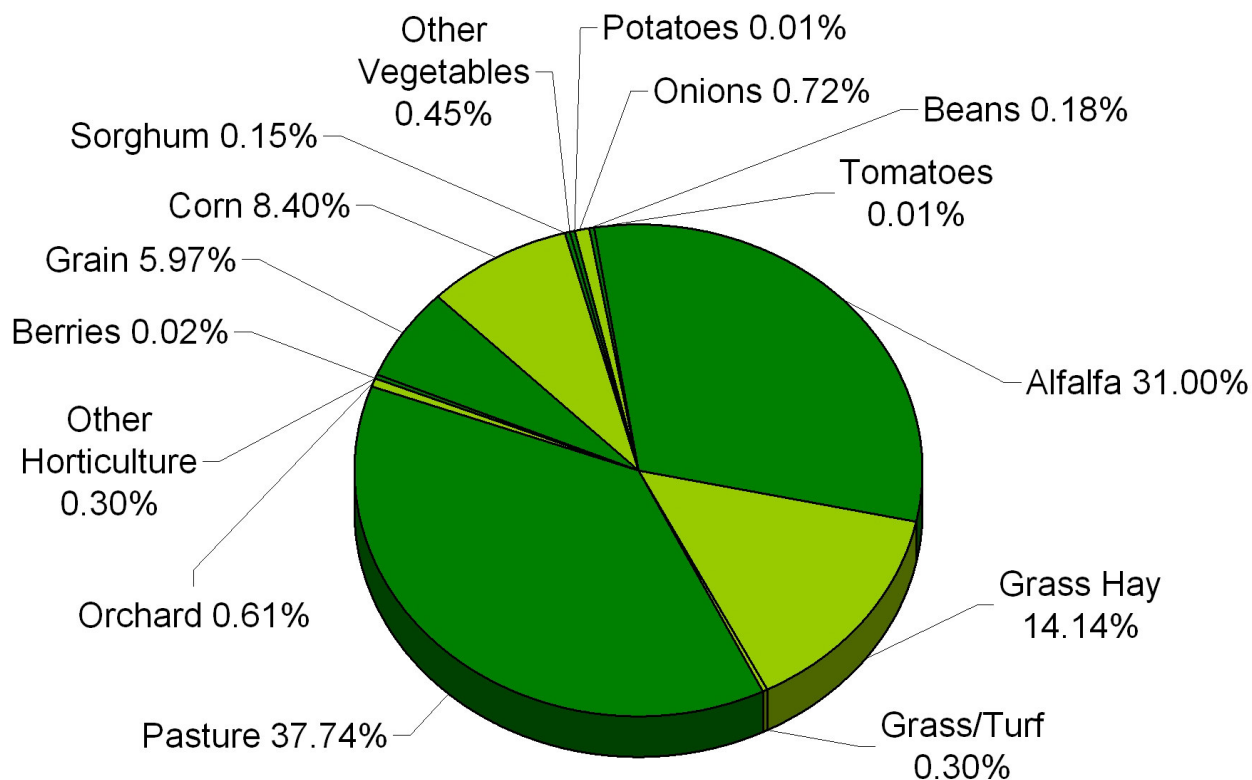


Table 1 Weber River Basin Land Use Summary of Land Cover by County for 2007

WEBER BASIN LAND USE 2007 (Acres)							
Code	Cover	Box Elder	Davis	Morgan	Summit	Weber	Basin
Surface-Irrigated							
IA1a	Orchard	199	210	2	11	88	510
IA1e	Berries	0	15	0	0	0	15
IA1f	Other Horticulture	0	233	0	0	16	249
IA2a	Grain	163	1,140	946	494	2,214	4,957
IA2a1	Corn	787	1,939	577	0	3,674	6,978
IA2a2	Sorghum	0	8	48	0	66	122
IA2b	Other Vegetables	19	199	0	0	153	371
IA2b1	Potatoes	0	9	0	0	0	9
IA2b2	Onions	0	395	0	0	206	601
IA2b3	Beans	0	148	0	0	0	148
IA2b4	Tomatoes	0	0	0	0	8	8
IA3a	Alfalfa	968	4,066	4,219	3,302	13,201	25,755
IA3b	Grass Hay	65	573	1,643	6,211	3,258	11,751
IA3c	Grass/Turf	0	214	0	0	33	248
IA3d	Pasture	1,105	5,637	1,787	10,855	11,975	31,358
Irrigation Method							
	<i>Flood</i>	3,137	11,231	6,592	15,904	30,160	67,024
	<i>Sprinkle</i>	170	3,556	2,631	4,968	4,731	16,056
	Subtotal	3,307	14,787	9,223	20,872	34,891	83,081
Sub-Irrigated							
IIA1a	Pasture-subirrigated	94	3,470	576	4,265	2,552	10,956
IIA1b	Grass Hay-subirrigated	0	0	0	155	14	169
	Subtotal	94	3,470	576	4,420	2,566	11,125
Non-Irrigated							
IA4a	Fallow	10	59	0	18	134	220
IA4b	Idle	539	2,604	117	1,343	5,495	10,097
IB1a	Dry Grain/Seeds	0	21	878	651	82	1,632
IB2a	Dry Alfalfa	0	396	1,010	347	830	2,583
IB2b	Dry Pasture	3	501	1,972	3,815	4,506	10,797
IB3b	Dry Idle	152	2,697	3,425	1,334	1,162	8,769
	Subtotal	703	6,277	7,401	7,507	12,209	34,098
Other Non-Irrigated							
IB2c	Range Pasture	0	4	130	2,019	147	2,300
Wet/Open Water Areas							
IIC	Wet Flats	3,737	4,090	0	167	26,971	34,965
IIE	Riparian	1,632	20,804	623	2,561	12,661	38,282
IIF1	Streams	55	164	651	727	703	2,299
IIF2	Reservoirs	10,032	270	1,058	2,801	3,228	17,389
IIF3	Ponds & Lakes	1,000	781	89	691	308	2,868
IIF4b	Sewage Lagoon	11	30	28	64	268	400
IIF4c	Evaporation Pond	4,253	15	4	0	7,283	11,556
	Subtotal	20,720	26,154	2,453	7,010	51,422	107,758
Residential/Industrial							
VA	Farmsteads	120	650	799	1,043	2,280	4,892
VB	Residential	884	38,511	2,843	18,406	36,033	96,676
VB3	Urban Turf Areas	14	2,681	255	908	2,641	6,498
VC	Commercial/Industrial	673	16,254	1,031	5,790	12,503	36,251
	Subtotal	1,690	58,096	4,929	26,147	53,456	144,317
Total Land Use/Land Cover		26,513	108,787	24,711	67,975	154,693	382,679

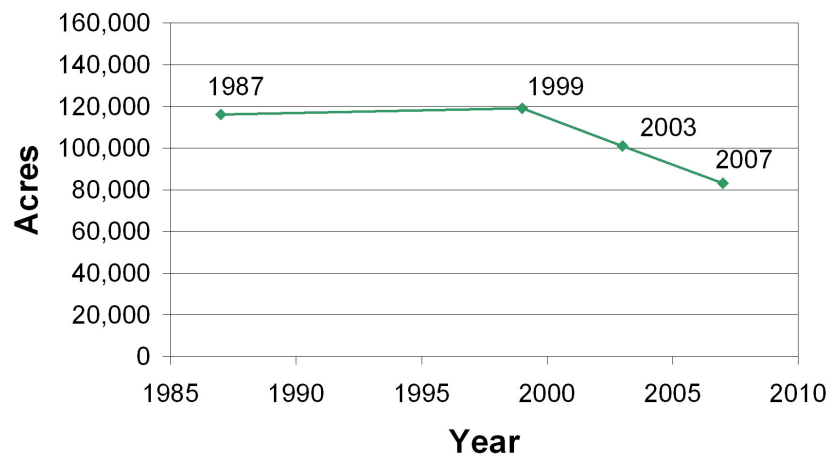
Table 2 Comparison of Land Cover Totals by Inventory Year*

WEBER RIVER BASIN LAND USE (Acres)						
	Box Elder	Davis	Morgan	Summit	Weber	Basin
1987 Land Use Summary						
Surface-Irrigated	3,478	29,635	10,693	28,178	44,144	116,129
Sub-Irrigated	712	6,553	707	957	17,787	26,716
Non-Irrigated	340	2,200	1,909	1,938	1,869	8,256
Other Non-Irrigated	0	0	0	0	0	0
Wet/Open Water Areas	18,707	30,483	2,685	6,255	31,269	89,399
Residential/Industrial	819	36,042	2,436	7,153	35,414	81,865
Total Land Use/Land Cover	24,057	104,912	18,431	44,481	130,483	322,365
1999 Land Use Summary						
Surface-Irrigated	3,968	27,760	10,330	29,900	47,136	119,094
Sub-Irrigated	0	73	3	231	1,798	2,106
Non-Irrigated	564	4,927	4,487	3,347	6,583	19,908
Other Non-Irrigated	0	0	0	0	0	0
Wet/Open Water Areas	10,767	10,340	1,825	3,676	30,767	57,376
Residential/Industrial	1,146	46,786	2,953	12,847	42,439	106,171
Total Land Use/Land Cover	16,445	89,886	19,598	50,001	128,724	304,656
2003 Land Use Summary						
Surface-Irrigated	3,373	23,362	10,507	24,833	38,875	100,949
Sub-Irrigated	125	2,651	7	3,455	2,051	8,289
Non-Irrigated	456	5,542	7,741	7,290	10,551	31,580
Other Non-Irrigated	0	0	0	0	0	0
Wet/Open Water Areas	20,689	22,618	1,918	5,423	47,654	98,302
Residential/Industrial	1,604	53,756	3,461	25,921	49,543	134,284
Total Land Use/Land Cover	26,246	107,928	23,634	66,922	148,673	373,403
2007 Land Use Summary						
Surface-Irrigated	3,307	14,787	9,223	20,872	34,891	83,081
Sub-Irrigated	94	3,470	576	4,420	2,566	11,125
Non-Irrigated	703	6,277	7,401	7,507	12,209	34,098
Other Non-Irrigated	0	4	130	2,019	147	2,300
Wet/Open Water Areas	20,720	26,154	2,453	7,010	51,422	107,758
Residential/Industrial	1,690	58,096	4,929	26,147	53,456	144,317
Total Land Use/Land Cover	26,513	108,787	24,711	67,975	154,693	382,679

* Please refer to the advisory on page 6 regarding comparisons between datasets.

Figure 5 Surface Irrigated Land Use Comparison Graph

Surface-Irrigated Land Use



Data Access

GIS data used in this summary may be downloaded from the Utah AGRC. The dataset is a 1:24,000 scale layer and is not intended to be used at a higher resolution. Current land use datasets are available as a statewide layer or by county and are offered in shapefile and geodatabase formats. To download the most recent dataset, Go to <http://gis.utah.gov/vector> and do the following: Select LandCover as the category, select a geographic extent and data format, click on Find Data. Click on WaterRelatedLanduse or download.

For past GIS datasets, Please contact Technical Services at the Division of Water Resources

Past Land Use Reports for this area and a PDF of this report can be found at

<http://www.water.utah.gov/planning/landuse/publ.htm>

Metadata is available at

<http://www.water.utah.gov/planning/landuse/gisdata.htm>

Additional Weber River Basin reports as well as many other reports can be found at

<http://www.water.utah.gov/planning>

REFERENCES

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2. Prism Group, Oregon State University, <http://prism.oregonstate.edu/>
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GLOSSARY

- I. Phreatophyte - A deep-rooted plant that obtains water from a permanent ground supply or from the water table.
- II. Planimetered or dot-counted - process to determine acreage by assigning an acreage value to a "dot" based on map scale and then counting the number of "dots" within a specific boundary.
- III. Heads-up digitizing - Manual digitization by tracing a mouse over features displayed on a computer monitor, used as a method of vectorizing raster data.